EDUCATION AND ECONOMIC GROWTH IN PORTUGAL: A SIMPLE REGRESSION APPROACH

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Introduction

Over the last two decades Portuguese economic growth has been a particular field of interest for Portuguese economic historians of the 19th and 20th centuries. Since 1980's special efforts have been focused on the quantitative appraisal of Portuguese economy during the two last centuries. Those investigations have been producing some comparatively long retrospective series of estimates of basic economic indicators. Public finance [Valério (1982); Mata (1985); Valério (1987); Silveira (1987)]; money supply and banking [Valério (1984); Mata (1987); Reis (1990); Sousa (1991)]; foreigh trade [Lains (1992)]; active population structure [Nunes (1989)]; prices and price indexes [Justino (1988) (1989)]; agriculture and industrial production indexes [Reis (1987)]; Lains (1990); national accounts [Justino (1987); Nunes, Mata, Valério (1990)] have been the most privileged fields of recent investigation.

The availability of these quantitative data introduced new grounds to debate the performance of Portuguese economy during the last two centuries and particularly to review the causes of Portuguese economic backwardness in an international comparative perspective.

The level and character of integration in the world economy, of natural, human and produced resources, institutional aspects, such as state intervention and banking institutions, have been reconsidered under pioneering theories tested for other countries before.

The quality and flexibility of economic resources, namely of labour, has been considered to be a decisive growth factor particularly since investigations on the causes of the post-second world war rates of growth in USA, European western countries and Japan. Actually, the relationship between education and economic growth is a matter that has been growing in interest among economists, since the last three decades after Schultz (1961a), Anderson, Bowman

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(1963) and Denison (1967), just to mention the earliest well known of their works. The subject has also focused economic historians attention, more recently, particularly after the so quoted works of Cameron (1985), Easterlin (1981), Sandberg (1979) and Sandberg (1982), in a somewhat different perspective.

Of the different approaches that have been used to assess the economic contribution of education, especially on economic growth, the one Bowen (1968) called «the simple correlation approach» has been particularly employed by economic historians[2]. This approach consists of correlating an index of educational activity and an index of economic activity. Cross-section models, actually cross-national and cross-regional comparisons have been used, among other aims, to «measure» the degree of association between education and economic performance and to test gaps in GDP per capita, as explained in Bowman (1980) - cause-effect relationship between human capital and growth is harder to prove. Regression models (both time-series and cross-section) of this type have also been used, for instance, to estimate income-elasticity of demand for education, as refered in Schultz (1961b) and to iluminate the time-lag problem as education is «a long-lived asset» - Mironov (1990) - and a relatively high income-elasticity good.

Only apparently does this matter seem incontestable. Actually, economic historians, in particular, are sensitive to the fact that the relative importance of sustained growth factors differs according to space and time and that the indispensability of a factor depends on the existence of alternative ones, forming a specific interrelated complex. Moreover, even if the existence of such a relationship could be taken for granted, many significant details have proved to be controversial.

As far as Portugal is concerned there are very few studies on education, or on human capital, from an economic, general approach[3].

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[2] See Tortella ed. (1990) *Education and Economic Development since the Industrial Revolution,* Valencia, Generalität Valenciana, 1990.

[3] Reis, J. (1989) is a recent study on literacy in Portugal in the 19th century; it is an interesting, relevant economic approach concerned with the economic and social reasons of Portugal's backwardness (relatively slow improvement) in the Mediterranean context, after the 1850's, in terms of literacy. The author built a model to predict the would be financial effort of Portuguese state to keep up with the literacy level of the European economies in a similar degree of development (pp. 102-105). He argues that the resources needed, both financial and human, were perfectly within the country's ability. According to J. Reis the main problem was "insufficient political will" and «lack of proper (political) motivation" — social and military peaceful time during the second half of the 19th century — in a country where market forces

The present paper attempts to present a very preliminary, limited, simple, statistical analysis of a new case study on the relationship between education and economic growth.

We were interested, for the time being, in measuring the degree of association between literacy, taken for the education variable, and GDP per capita, standing for the economic activity variable[4] to test some classical hypotheses, namely: a) The «literacy threshold» around 30-40% as a necessary condition for sustained economic growth, as suggested in Anderson and Bowman (1963) and Sandberg (1982); ***b)*** The existence of a significant statistical correlation between the two sets of data with a specific lag for GDP per capita (most case studies seem to suggest a time-lag between 20 and 35 years as having a rather high, if not the most significant statistical result); c) The existence of a significant statistical correlation between the two sets of data with a specific lag for literacy (in this case the results seem to be less consistent).

The heart of this study is a number of time-series regressions relating GDP per capita - annual data - for the years 1835 to 1990 and literacy rates (of the total population) - annual data - for the years 1878 to 1981, or adult literacy rates (people over 10 years of age) for the years 1890 to 1981. A larger number of cross-section regressions, relating the same two variables in 20 relevant regions with several time-lags, were also tried to test an eventual significant statistical explanation of differences in regional per capita GDP through literacy level differences among those 20 regions, in earlier periods. The methodology and sources of the estimates mentioned above are presented in the appendix.

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were inefficient especially from demand side; economic conditions — low per capita income and reduced opportunities in the labour market - were responsable for a low demand for education, namely primary education.

Ramos (1988) is an interesting study basically on social-cultural, regional, gender aspects of literacy in Portugal. Some remarks on economic aspects, namely propriety structure, are also discussed.

[4] Though these choices may be questioned they have been used for similar purposes to deal with very different case studies such as Spain - Nunez (1990) - and Russia/USSR - Mironov (1990) - and cross-national comparisons - Anderson; Bowman (1963) and Sandberg (1982) - , with substantive, significative results.

Actually, specially if the analysis focuses on early stages of economic growth and/or the adult literacy rates are not sufficiently close to 100%, as the case is, their relative advantages seem to be significant.

On the advantages and drawbacks of using literacy as an estimator for education instead, for instance, of years of schooling or school enrollments, see Tortella, ed. (1990), and Bowman (1981).

The use of GDP (per capita) to measure growth is, despite all the inconvenient systematically point out in Kuznets (1954), the best synthetic variable of the economic performance of an (national) economy.

1 — Literacy threshold

Time series of overall literacy, adult literacy rates and per capita GDP are presented in table A, below.

It is worth emphasizing some brief general remarks. As far as literacy rates, both total and adult, are concerned the most striking in the long-term trend is their very slow increase, a fact already noticed and discussed in Reis (1989), as mentioned in note 2 above, and in Ramos (1993). Actually it took almost a century to reach the 70% literacy threshold, and by 1981 universal literacy was still far.

According to the estimates of per capita GDP, Portuguese economic growth has only become sustained after the Second World War, showing high growth rates per year, especially during 1946-1973 (5.2%). Till then, some periods of moderate but irregular growth (1860-1888; 1922-1941), alternated with periods of near stagnation (1833-1859; 1889-1913)[5]. Further arguments to date modern economic growth in Portugal after the late 1940's and early 1950's, based on rather thorough analyses of the sectorial structure of labour force in Portugal from 1890 to 1981 are to be found in Nunes (1989) and Nunes (1991)[6].

Therefore, Bowman and Anderson suggestions, corroborated by Sandberg, that 30-40% of literates of the total population is a necessary threshold for sustained growth, is still confirmed.

2 — Literacy and per capita GDP

As S. Kuznets noticed about the problem of association and causation, specifically concerning income levels and some associated characteristics[7], correlation analyses, from the statistical point of view, as mentioned above, are useless, as such, to determine a cause-effect sequence of the relationship

[5] For further details on the aggregative aspects of Portuguese economic growth since the 1830's see Nunes, Mata, Valério (1989).

[6] Only after 1950's does Portuguese economy show a significat rhythm of structure modernization. Till then industrial share in labour force was 24% while agriculture share was still 48% (61% in 1890). In the early 1980's those figures were respectively 38% and 18%. The service sector, including commerce, public administration and defence, and other services, took up respectively 23% and 37% of active population.

[7] «[…] Because of this interaction of income level and other characteristics [industrial structure, literacy, patterns of population growth], the *statistic association* between them is no basis for assuming that this characteristics are causative factors […]» in Kuznets (1924), p. 225.

between any two variables. In the correlation analysis the coefficient of correlation *(r)* measures the linear association between (the) variables.

However, a time-lag cause-effect relationship between education and economic growth bears logic, economic meaning in both directions.

It takes time before education, namely literacy, may influence GDP (and per capita GDP) either through its more direct productivity and allocation effects or through its more diffuse effect, for instance, on attitudes[8]. Education is an investment whose private returns, rise in real earnings per worker, and accumulative social returns are not immediate.

On the other hand, education, both private and public, envolves costs; the ability to bear them depends on a relatively high level of income per capita and on economic expectations of future incomes.

Therefore there is ground to run simple regressions, using the OLS method, both considering literacy as the independent, explanatory variable and per capita GDP as the dependent one and suggesting the reverse cause-effect sequence. Apart from the estimation of regression coefficients and their statistic significance - standard errors, *t*-statistic value, *F*- statistic value — regression analysis is statistically assessed by the coefficient of determination (r^2) (or the adjusted coefficient of determination (r^2) that measures the «goodness of fit» and the percentage of the total variation in the dependent variable explained by the regression model (the independent, explanatory variables).

We tried to find out after what time-lag have changes in literacy levels had a (more) significant impact on per capita GDP and, reciprocally, after what time-lag have changes in income levels had a larger effect on basic education in Portugal.

A — Time-series analysis

First we ran the time-series regressions. As far as the regression analysis is concerned we faced the inevitable problems of autocorrelation. The use of a

[8] Further analysis on how education, and literacy, fosters economic growth can be read in Schultz (1961b), Bowman (1981), Tortella ed. (1990). As far as sustained growth is concerned, S. Kuznets emphasized in Kuznets (1987) that modern economic growth depends on diffusion of science-based innovations which requires formal educated labour force to explore them efficiently. To test specifically modern economic growth, enrollments or number of years attending school, would be more convenient proxy variables to the education level.

model that excludes many explanatory variables (further remarks on this bellow and in note 9), the fact of raw data «manipulation» (see the appendix on interpolation of censuses data to compute annual literacy rates) showed that the problem did not fall short of our expectation. Actually, the computation of the Durbin-Watson statistic revealed a very low figure. In this case the very high values of F and t tests of significance loose credibility and the standard errors of the estimators are probably underestimating the real ones. Fortunately our aim is not prediction. Yet, figures on the statistical results of the relevant regressions, but the Durbin-Watson, are shown in table B, below.

The correlogram gives a more impressive, clear view of the results. The right side of it corresponds to the first set of regressions - literacy as the explanatory variable - and the left side to the second set of regressions - per capita GDP as the explanatory variable. The curve represents the regressions using annual values of both series. The original per capita GDP series, shown in table A, was transformed in the index 1990 =100.

Other regressions were run aiming at checking the validity of the former results, and reducing the eventual criticisms on the roughness in measurement thanks to the shakiness of data, namely the figures of per capita GDP till 1930's, reflected in the sharp, short term fluctuations; the annual data series of per capita GDP was rebuilt as a series of a fourth rank moving media to smooth the original data. As far as the literacy data is concerned the annual data series was reduced to the figures of the censuses not combed with interpolations, which often cause statistic problems. The hypothesis of dealing with a time-gap limited to 50 years maximum could have also been a cautious decision.

The comparison of the results of two sets of regression just mentioned proved to be very similar. Again, the similarity of the regression and correlation results taking overall or adult literacy rates is remarkable as these two series are highly correlated[9]. We chose to use the literacy rates series as it is longer.

So we will dare to comment the figures supporting the correlogram, included in table B, which shows the results of the statistical analysis, of every 5 years time-lag regressions.

[9] Literacy rate = adult literacy rate x .948 – 4.059

Let us begin with the analysis of the regressions considering per capita GDP as the dependent, lagged variable: p.c. GDP = *f(%* literates).

The results of the statistic analysis show that the degree of association between literacy and economic growth (*r*), is always very high, certainly too high[10], taking any tested time-lag. The adjusted determination coefficients (r^2) are in the interval .767 - .972 if we use literates out of total population (.787 - .978 if adult literacy is taken as the independent variable).

A more detailed look at the figures of *r* and t^2 reveals a certain periodicity. The first peak is observed at a time-lag of around 30 years; the second one, at a 55-60 years time-lag; a third maximum at a time-lag of 85-95 and it is growing at the last possible tested time-lag of 105 using literates out of total population. So a 25-35 years time-lag seems to be the one reflecting the strongest relationship between education and economic growth, using literacy and per capita GDP as proxy variables.

This result confirms previous similar conclusions from other case studies [Spain in Nunez (1990), Russia/URSS in Mironov (1990), and Japan in Hanley (1990)] and is credited with social historical evidence. 25-35 years is the normal time span from the moment one gets its primary education to the moment one is fully adjusted to his professional activity.

As adjusted determinant and correlation coefficients figures are rather close along the analyzed period, and it is impossible to test time-lags of more than 105 (literacy rates for total population), for lack of degrees of freedom, it is risky

[10] According to the statistical meaning of the coefficient of determination, this figures mean that around 80% of the level of per capita GDP is explained by literacy during the time span under investigation. Obviously this is not feasible as there are many other important factors of economic growth as has been statistically proved using more realistic models of several explanatory variables, as is discussed in Maddison (1991), not to quote classical studies as the ones of Denison. Actually, as explained in Mironov (1990), pp. 116-117, due to the use of «one-factor model […] the calculated determination coefficients can not reflect the net contribution of the "education factor" to economic growth. They also reflect the contribution of other factors which we did not take into account and which affect economic growth not directly but indirectly, through education. Indeed, the economic potential of society results from the action of many factors, including, perhaps, all those that affect economic growth as well […] The "education" factor should therefore correspond to all others factors of economic growth and indirectly reflect their influence.» A more realistic model would probably be of the autoregressive type, which would help to overcome the autocorrelation problem.

However, as far as Russian/URSS case study is concerned, the author device to depict the net contribution of education from the original set of coefficients did not alter his original conclusions on the time-lag rhythm of effects of education on economic growth.

In Kuznets (1954), p. 225, the author with regard to explaining international differences in income levels, states «Factors such as population growth pattern, literacy, industrial structure, and capital investment are of *some* importance in determining international differences in levels of income. But their importance *per se*, is much more limited than their close statistical association with per capita income suggests. Their *net* effect, if it could be measured, might account for but a small part of the existing differences, and therefore leave much room for further search and explanation.»

to foresee the time span of an eventual cumulative effect, of say, 120 years, as it is suggested in Sandberg (1982), and for Japan in Hanley (1990). Once maximum values of the coefficients are rising (though slightly) as time-lags are larger, it is tempting to suggest such an hypothesis, all the more since a peak at 120 years time-lag would be 25-35 years after the last one detected at a time-*lag of 85-95.*

Table B also presents the results of the adjusted determination and correlation coefficients, r^2 and *r,* for every 5 years time-lags of literacy, considering it as the independent variables in running the regressions: % literates = *f* (p.c. GDP).

The results of the statistic analysis shows a relatively high degree of linear association with literacy rates time-lags varying from 0 to 90 years. The adjusted determination coefficient are above .5 except for time-lags of 50-55 years, taking literates out of total population (45-50-55 and 90 years taking adult literacy); in this cases r^2 are still above .4 (if we take r^2 instead of r^2**,** the number of exceptions would be reduced). For time-lags above 90 years coefficient values show figures of no statistic significance and with short fluctuations.

A more detailed analysis reveals a first peak at a time of 20 years time-lag and a much more significant one around a time-lag of 65-70 years. Notice that 140 years time-lag may be a peak (though not at a significative statistical level).

So, it seems that an improvement in per capita GDP has some positive effect in the level of education some 20 years ahead and especially some 70 years after, what seems to be quite a long time span.

Though an hypothesis of a 70 years periodicity may be foreseen, the effect of a raise in the country's economic performance looses impact on its education ability after the first 7 decades, and, as mentioned above, at 140 years time-lag the eventual relative peak is of no statistical significance.

Comparing the two cause-effect sequences of the relationship between literacy and economic growth, apparently, changes in the educational level of population are determined in a lower proportion by per capita GDP, than the reverse effect. Actually, the adjusted determination coefficients of regressions where the dependent, lagged variable is the literacy level are lower (maybe too

low once we are running time series regressions) than the ones where it is the explanatory factor[11].

A more interesting aspect of the observed reciprocal cause-effect relationship between literacy and economic growth is the eventual existence of a chain mechanism. The hypothesis of a chain link of alternate positive effects of the type ... literacy -> economic growth -> literacy -> economic growth -> is tempting. There would be two (or three) time span links; 25-35 years after a spur on literacy level (probably of formal primary education), there would be an increase in per capita GDP which would raise demand and supply of education, namely basic education, first, some 25 years ahead, and more clearly some 65-70 years later. Obviously, we would never know whether education or economic growth would be the starting point of the chain. This hypothesis has to be systematically tested against other quantitative and qualitative data and has to take into especial account institutional aspects, as, for instance, the start of compulsory primary education.

Such a test is far from being an easy task and, what is certainly less stimulating, may be considered as hardly conclusive. Further relevant quantitative evidence, is scanty for most of the period under analysis.

Taking only some information on public attitudes towards education and instruction, though not very detailed for most of the period under consideration, we will risk, notwithstanding, the exercise of checking the chain mechanism stated above against some quantitative and qualitative information on public attitude towards education and particularly primary education.

As far as quantitative data is concerned, some relatively recent economic studies on public finance allow us to depict the evolution of the functional structure of public expenditures, which includes a figure (for most of the period, an overall figure) on education[12]. Data is only available since the second half of the 19th century. Qualitative information is available in Carvalho (1986) a study on the history of teaching in Portugal till the end of Salazar-Caetano regime.

The proportion of public expenditure on education from the 1860's to the 1910's hardly changed: 3% is the average figure with very small annual

[11] Probably, according to the explanation in note 9, the differences of the level of the coefficient values are also a consequence of the relative number and importance of indirect effects of other explanatory factors gathered on the two sets of simple regression models run.
[12] See Mata (1985), Valério (1982), Mata, Valério (1990).

deviations of only ±1%; in the 1860's and the years before the First World War, the figure attained 4% (and exceptionally 5% in 1910-1911 and 1912-1913). The decade after 1874 and the 1890's public expenditure on education took only 2% of the total. During the First World War public expenditure on primary education accounted for ⅓ of total expenditure on education. The 1920's, corresponding to the last years of the democratic republican regime, are the years of a radical change in the structure of public expenditures in favour of education and especially of primary education. The proportion of education on total jumped to a 9% average figure and primary education took $^1/_2$ of the total expended on education. These figures would remain till the beginning of the Second World War, corresponding to the first years of an authoritarian regime that would last till 1974. During the Second World War the 9% figure went slightly down to 8% and primary education fell to ⅓ of total public expenditures on education. From 1946 to 1974 education averaged 10% of total public expenditure and from then to 1988 the figure rose to 14%.

The most striking, and most inconvenient to our purpose, aspect of a synthetic view on qualitative evidence on this matter, is the large political instability of the 19th and 20th century and its obvious negative consequences as far as the implementation of an educational policy is concerned. Actually, even in periods of relative regime stability, as most of the second half of the 19th century, the rotation of prime ministers was far too quick and their educational reform decrees, namely of primary education, were revoked as soon as their successors took over. Till the second half of the 20th century, most prime ministers were out of government in a couple of months, and so, their educational reform (if it had had time to be regulated and implemented), would have been canceled and, eventually, a new reform regulated and implemented.

A second aspect worth emphasizing is the inexistence of a separate state department for education before 1913. The two previous attempts to create a State Department of Education were short-lived due to more or less serious financial crises: in 1870 it lasted two months; in 1890 it lasted 3 years.

A third aspect concerns compulsory primary education. Only legally can it be considered to have been introduced in 1835, 1844 or, more accurately, in 1911, as it soon proved not to be practicable for economic and social reasons. Apparently, only in the beginning of 1950's there is quantitative evidence of

compulsory primary education being accomplished. In 1950 still 20% of 7 to 11 years old children were not attending school; in 1955 that proportion was reduced to 1%. Only in 1960 did compulsory education attain 4 years of schooling.

A very broad analysis suggests a period of important reform of primary teaching during the last quarter of the 18th century, which aimed at creating a regional network of primary schools, and under a general ideological attitude favouring education[13] (period of relative economic prosperity).

The first third of the 19th century seems to have been detrimental to schooling, thanks to political and military instability, including the wars with Spain and France (1801 and 1807-1814), and a civil war (1828-1834). In 1829 around ⅓ of primary schools were extinguished, a measure that had already been taken in 1823 for the same economic reasons. Though political instability went on to 1851, some ministers tried to implement primary education reforms, taking into account previous efforts in this field. Actually, some aspects of Rodrigo da Fonseca's reform in 1835 were respected in Passos Manuel's reform (1838) and both contributions were attended in the legislation of Costa Cabral (1844) on this matter.

As we refered above the first decades of the 2nd half of the 19th century brought some stability and some economic growth. Apparently the most important innovation were technical schools, at least during the first two decades. During the 1870's some primary teaching reforms were thought out (1870 and 1878) but hardly implemented. Some private iniciative was taken and some important pedagogic innovation, concerning the teaching of reading and writing, began its diffusion which would last many decades ahead.

Republicans would only take power in 1910 but their political and social pressure was actually felt, very deeply, from 1890 on. One of their *leit motiv* was certainly primary education. They would try to implement what is still considered to have been a very good reform of primary education, including a very large concern with the quality of teachers. The number of primary schools increased, but war, political instability and economic financial problems prevented this effort to be more fruitful.

[13] Two important institutions were founded standing for the especial athmosphere of this period: the Academia Real das Ciências de Lisboa (1779) and the Real Casa Pia (1780).

Authoritarian regime, especial under Salazar, has traditionally widely been accused of having had basically negative influence on the level of education and instruction in Portugal, for ideological and political reasons[14]. Actually the slow improvement of the rate of literacy and the inability to garantee compulsory primary education, till 1950's, may, apparently, support such thesis.

Time comes to try to see into these information to test, without going into detail, the above mentioned hypothesis of a chain relationship between economic growth and literacy level. Till the first decade of the second half 19th century the estimates on GDP per capita show acute short term fluctuations and a near stagnation trend, so, apparently, the expected GDP growth after the first quarter of the 19th century, that would be induced by the favourable educational developments of the last quarter of the 18th century, cannot be depicted. However, taking in consideration the large margins of error accepted for those estimates for that period, and the evidence of an industrial conjunctural spurt (1835-1850) and of some institutional changes[15], after the civil war between absolutists and constitutionalists (1828-1834), we may accept some signs of economic development some 35 years after significant measures in favour of education. Some 25 years later, in 1870's, as stated above, improvements on teaching methods may correspond to an eventual slight raise in demand and supply for education, namely primary education, reinforced around 1910's and 1920's with the Republican regime. This effort on primary education was fruitful 25-35 years later, as expected. Actually, by then, around 1950's, modern economic growth was at last gaining ground on Portuguese economy and some 25 years after the rythm of increasing literacy was raising.

Naturally, the periods in which improvements on education are more apparent, are also moments of comparative prosperity. That is the case in the last decades of the 18th century[16], again in 1860's, 1870's and most of the 1880's, in the 1920's and in 1980's.

[14] M.F. Mónica, has been studying for some time cultural aspects of Portuguese society under Salazar regime. See specially Mónica (1978).
[15] See Godinho (1955), Serrão, Martins (1977).
[16] See again references in note 14.

B — Cross-section analysis

Let us now turn to cross-section regression analyses.

According to the time series regression and correlation analyses, we found a time-lag of around 30 years to be the most significant. Actually, the closest relationship between literacy and economic development, namely the strongest impact of the former on the latter, seems to be reflected some 25-35 years after an eventual spurt of basic education. Figures also reveal that every 25-35 years the association of those variables is relatively stronger than in the years in between. We took these results as indicators to select the potential relevant time-lag worth considering in view of running cross-section regressions. Naturally, special attention was given to the 25-35 time-lags.

Tables C and D show figures on regional literacy rates and per capita gross domestic product (GDP) or gross added value (GAV), respectively, as they were used to undertake the statistical analysis. For the present purpose, and taking into account the availability of data, the country was divided into 20 relevant regions, namely the 18 *distritos* - an administrative division - of the Mainland and the two archipelagos of Madeira and Azores. The appendix on methodology and sources, below, includes further details and account for a minor exception of the regional scope.

We are not concerned here to describe or analyze regional differences neither on literacy rates nor on economic development, though those differences are very apparent and make a point to the discussion on the relevant spacial scope to be considered when modern economic growth is the subject.

However, as expected, the statistical results on tables E and F, considering different time-lagged cross-section regression and correlation analyses, show coefficients of correlation and of adjusted determination considerably lower than the ones revealed in the time-series analyses. This means that some regions show a relatively high literacy rate though their per capita GDP, some time later, is comparatively low.

The comparison of tables E and F confirms these findings. Table F includes the statistic results taking data from the Mainland, while table E includes also data from the Islands, where, namely Azores, in most censuses, show a com-

paratively high literacy rate[17] ranking this region in a position that does not match its rank as far as economic development is concerned[18]. Statistical results, namely the regressions fit are, clearly, better when the 18 administrative divisions of the Mainland, alone, are considered.

Social, institutional and cultural factors influence regional patterns of literacy; those factors are smoothed at national scope but they may be quite apparent at regional level. Actually, factors as migration expectations, migration sexual structure, migration destiny (national or international); location of religious orders - and their subsequent suppression -; type of property; insertion of women in agriculture activities, among others, are responsible for regional (and also national), particular types and levels of literacy patterns, and their economic impact may not be felt ever, significantly, on that region. This is the case if, namely, it is an emigration region. Azores, and some Northern interior areas of the Mainland as Viseu, Vila Real, Guarda are for comparatively long periods, outstanding examples. Again, this is not the purpose of this paper.

How far do the statistical results of cross-section analysis corroborate the ones from time-series regressions?

Tables E and F summarize the results of the regression and correlation analyses we considered to be relevant. As we stated above, our main point was to check time-lags of 25-35 years, as, broadly, leading to rather significant correlation and adjusted determinant coefficients, in a context of good fits.

According to available data, the first regression taking time-lags close to that time span is 1900 -> 1938, standing for 1938 per capita GDP = /(1900 literacy rate), and the last one is 1985 per capita GAV = f(1960 literacy rates), schematizing, 1960 -> 1985. Statistical results are quite confident. Only for 1920, 1940, 1950 literacy rates, taking the whole country, and 1940, taking only its Mainland, do the adjusted determinant coefficients and the coefficient of

[17] The Azores Islands also show an unexpected gender pattern characterized by female literacy rates clearly above male literacy rates. A couple of examples: according to the census of 1920 they were respectively 38.0% and 30.4%. In 1940 the corresponding figures were 39.6 and 46.0%.

[18] This difference in ranking according to literacy and according to economic development is still smooth by the fact that the method used to estimate regional per capita GDP, as stated in the appendix, lays on the assumption of equal productivity throughout the country in each branch of activity, which certainly favours Azores.

correlation show figures clearly below .5 and .7 respectively, when taking time-lags of 25-30-35.

The fact that if we reduced the time lags to 20 years in case of taking 1940 and 1960 as independent variable, that is to say, if we ran 1940 -> 1960 and 1960 -> 1980 regressions, we would find r and r^2 above .7 and .5 (the same would even happen with 1970 -> 1985 regression) may be an interesting finding. It may point out that from the moment a certain national literacy threshold is attained (apparently the first threshold, referred above), the higher the level of literacy, the shorter the time-lag needed to the impact of education to 'be significantly felt on the economic performance, and the better the coefficients of determination and correlation.

The results of regressions taking longer time-lags, namely of 55-60 years, seem to confirm this. Except for 1878 -> 1938, 1890 ->1950, 1900 -> 1955/ 1960; 1930 ->1980/1985, where the coefficients are definitely high, the consideration of these longer time-lags reflects r^2 rather low, and always lower than taking shorter lags (with the apparent exception of 1930 -> 1985), although all significant tests remain positive and significant with minor exceptions (a couple of F-statistic roughly below 9.5).

Conclusion

Some broad qualifications must be noticed and bring this preliminary study to a simple contribution, a mere exercise, on this matter.

Improvements to national account estimates, especially before 1950's, and to regional accounts are, of course, still expected. Since this paper is strictly based on the existing available estimates, its findings are to be discussed and eventually revised in the (near, I hope) future. Inserted as it is in larger scopes, namely the explanation of Portuguese economic backwardness, the consideration of more complex explanatory models envolving other factors of growth is expected to enlight the subject.

As far as education is concerned, literacy is probably its most easily available indicator specially in a country where statistical data is scanty. School enrollments, data on technical education, analyses of gender gap, are also classical variables standing for education and used for similar analyses. Efforts

to estimate and use long-series of other related or proxy variables, are still welcome and they also may discuss some of the conclusions and qualifications of this study.

Nevertheless, for the time being, our findings on the contribution of education, namely literacy, to (modern) economic growth, and the time-lags of its major impact, seem to adjust to similar, prior case studies.

APPENDIX

1 — Computation of literacy rates

A — Methodology

Official estimates of population and literates are available in the 12 population censuses covering the period 1864-1981. Those counts took place in the years of 1864, 1878, 1890, 1900, 1911, 1920, 1930, 1940, 1950, 1960, 1970, 1981 (preliminary results of 1991's census are now coming out but figures on literates are not yet available). Data is available on a regional basis. Some setbacks, due to inevitable differences in the arrangements of the information presented in the censuses along such a time span (almost 120 years), did not prevent an apparently rather homogeneous set of data for the 20 relevant regions considered (the 18 *distritos* of the Mainland, and the archipelagos of Azores and Madeira). Yet, as far as 1878 census is concerned it is only possible to gather data on literacy for 19 regions as, by then, the would be *distrito* of Setúbal, created in 1926 (decree no. 12 870, Dec. 22), was a part of the *distrito* of Lisboa. There is no corresponding data on *concelhos* - the administrative divisions of the *distritos* - so we could artificially breake up the *distrito* of Lisboa and to compute literacy levels in the areas that would correspond to the new *distrito* of Lisboa and to the one of Setúbal; the same is not true of the censuses of 1890, 1900, 1911 and 1920 where it is possible to undertake such computations.

Linear interpolation between every two consecutive census was the method to produce a year to year estimate of literacy rates.

A similar procedure was used to compute a year to year estimate of adult literacy rate (people over 10 years of age) for the period 1890-1981. The census of 1878 presents no information on literates by age groups; the census of 1864 presents no information on literates.

All census counted literates (and obviously population) by sex.

B — Sources

Censo da População de Portugal – 1864, published by the Direcção-Geral de Estatística.

Censo da População de Portugal – 1878, published by the Direcção-Geral de Estatística.

Censo da População de Portugal -1890, published by the Direcção-Geral de Estatística.

Censo da População de Portugal - 1900, published by the Direcção-Geral de Estatística.

Censo da População de Portugal - 1910, published by the Direcção-Geral de Estatística.

Censo da População de Portugal - 1920, published by the Direcção-Geral de Estatística.

Censo da População de Portugal - 1930, published by the Direcção-Geral de Estatística.

VIII Recenseamento Geral da População - 1940, published by the Instituto Nacional de Estatística.

IX Recenseamento Geral da População - 1950, published by the Instituto Nacional de Estatística.

X Recenseamento Geral da População - 1960, published by the Instituto Nacional de Estatística.

XI Recenseamento Geral da População - 1970, published by the Instituto Nacional de Estatística.

XII Recenseamento Geral da População - 1981, published by the Instituto Nacional de Estatística.

2 — Computation of per capita gross domestic product (GDP) at 1914 market prices

A — Methodology

The year to year estimates of per capita gross domestic product at 1914 market prices, for Portugal, were previously published in our paper «Portuguese Economic Growth 1833-1985», in *The Journal of European Economic History,* vol. 18, no. 2, Fall 1989 (in collaboration with Eugenia Mata e Nuno Valério). The paper includes, at the appendix, a detailed explanation of computation of GDP, population, the deflator and GDP per capita. Figures for 1981-1985 were corrected to take into account the results of the 1991 census. Figures for 1986-1990 were computed by the very same method explained in the paper just quoted and are to be published in a forthcoming paper by Nuno Valério.

Only very recently have some official estimates of GDP (actualy gross added value at current prices) on a regional basis been published, by the Instituto Nacional de Estatística for the years 1980 on for the Mainland (excluding the archipelagos of Azores and Madeira).

For the years 1952, 1954, 1956, 1958 *in* Loureiro (n/d) and 1970 *in* Caramona, Conceição, Amorim (1972) some estimates were computed, again just for the Mainland.

In our Ph. D. Thesis, Nunes (1989), we tried to estimate regional (actually 18 *distritos* of the Mainland, Azores and Madeira) GDP for the years of 1938 and 1947-1980 using labour force data and the assumption of equal productivity throughout the country in each branch of activity. To compute per capita figures we used our annual estimates of regional resident population also available in Nunes (1989). Our choice for our estimates is explained in face of the relative homogeneity and length of the series and because they concern the whole country. Nevertheless, we also computed data from the other sources mentioned to wide the time scope and to check our results. Whenever relevant we include in the tables figures and statistical results of regressions using these data.

To run cross-section regressions using regional literacy rates of 1878, we had to get a unique figure of per capita GDP (or GAV) for the area covered by

the two *distritos* of Lisboa and Setúbal for the reason explained above, in this appendix. That figure is the weighted average of the two original values.

B — Sources

Loureiro (n/d).

Caramona, Conceição, Amorim (1972).

Nunes (1989).

Nunes, Mata, Valério (1990).

Valério (1993).

FIGURE 1

Literacy gap correlogram

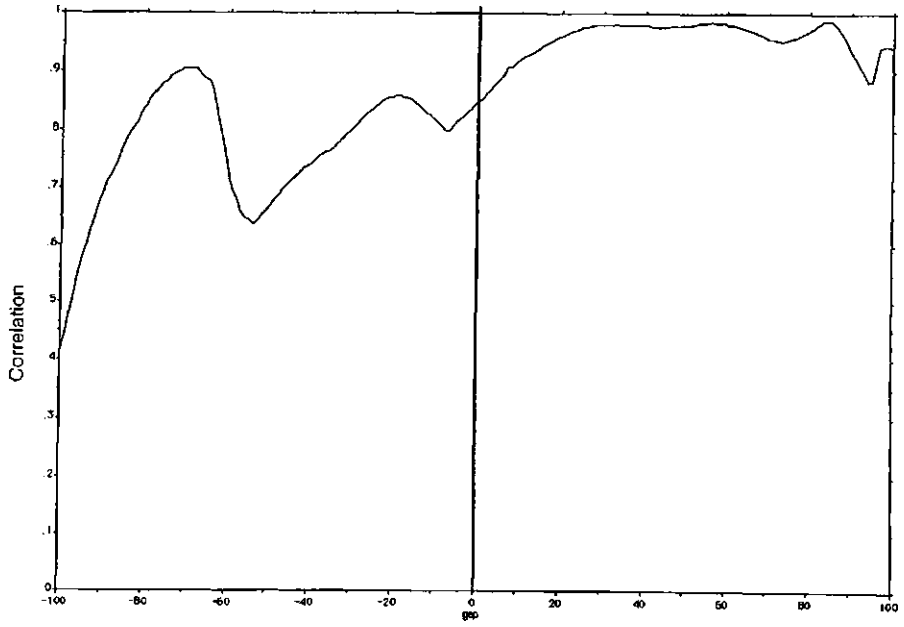

TABLE A

Economic growth and literacy in Portugal: basic data

Year	Per capita GDP 1914 prices escudos	Literacy rate	Adult literacy Rate (literates aged 10 or more)
1833	116	•	•
1834	104	•	•
1835	85	•	•
1836	88	•	•
1837	106	•	•
1838	98	•	•
1839	93	•	•
1840	86	•	•
1841	101	•	•
1842	109	•	•
1843	124	•	•
1844	122	•	•
1845	99	•	•
1846	103	•	•
1847	114	•	•
1849	107	•	•
1850	95	•	•
1851	102	•	•
1852	109	•	•
1853	89	•	•
1854	75	•	•
1855	82	•	•
1856	71	•	•
1857	87	•	•
1858	97	•	•
1859	86	•	•
1860	88	•	•
1861	88	•	•
1862	93	•	•
1863	98	•	•
1864	100	•	•
1865	103	•	•
1866	97	•	•
1867	95	•	•
1868	102	•	•
1869	107	•	•
1870	115	•	•
1871	115	•	•
1872	121	•	•
1873	123	•	•
1874	126	•	•
1875	133	•	•

1876	133	•	•
1877	120	•	•
1878	120	18	•
1879	121	18	•
1880	129	18	•
1881	131	18	•
1882	131	19	•
1883	135	19	•
1884	149	19	•
1885	158	19	•
1886	162	20	•
1887	167	20	•
1888	176	20	•
1889	168	21	•
1890	151	21	24
1891	154	21	24
1892	153	21	24
1893	151	21	25
1894	150	21	25
1895	166	21	25
1896	169	21	25
1897	158	21	26
1898	152	21	26
1899	157	21	26
1900	164	21	27
1901	160	22	27
1902	165	22	27
1903	163	22	28
1904	156	23	28
1905	157	23	29
1906	158	23	29
1907	162	24	29
1908	164	24	30
1909	163	24	30
1910	170	25	31
1911	152	25	31
1912	159	25	31
1913	157	26	32
1914	142	26	32
1915	145	27	33
1916	148	27	33
1917	136	28	34
1918	102	28	34
1919	113	29	34
1920	103	29	35
1921	90	29	35

1922	123	30	36
1923	126	30	36
1924	121	30	37
1925	137	31	37
1926	148	31	38
1927	145	31	38
1928	174	32	39
1929	187	32	39
1930	189	32	40
1931	199	33	41
1932	204	34	41
1933	206	35	42
1934	209	36	43
1935	209	36	44
1936	204	37	45
1937	204	38	45
1938	216	39	46
1939	227	40	47
1940	225	41	48
1941	242	42	49
1942	236	43	49
1943	228	44	51
1944	214	45	52
1945	205	46	53
1946	209	47	54
1947	223	48	55
1948	224	49	56
1949	225	50	57
1450	237	51	58
1951	244	52	59
1952	244	53	60
1953	260	54	61
1954	274	55	62
1955	282	55	63
1956	293	56	63
1957	306	57	64
1958	320	58	65
1959	336	59	66
1960	355	60	67
1961	373	60	68
1962	394	61	68
1963	417	62	69
1964	441	62	70
1965	476	63	71
1966	505	64	71
1967	549	64	72

1968	596	65	73
1969	619	66	74
1970	685	66	74
1971	733	67	75
1972	795	68	76
1973	894	68	76
1974	870	69	77
1975	782	70	78
1976	813	70	78
1977	872	71	79
1978	898	72	79
1979	952	72	80
1980	983	73	81
1981	994	74	81
1982	1014	•	•
1983	1013	•	•
1984	994	•	•
1985	1024	•	•
1986	1066	•	•
1987	1121	•	•
1988	1166	•	•
1989	1224	•	•
1990	1275	•	•

TABLE B

Statistical results of time-serie regressions

Gap (years)	Degrees of freedom	Correlation coefficient(r)	Determination coefficient(r^2)	*F*-statistic	*t*-statistic	Coefficient (β_1)
I - Real per capita gross domestic product as a function of the literacy rate						
0	103	.850	.720	265	16.3	.858
5	103	.889	.788	383	19.6	1.073
10	102	.919	.842	546	23.4	1.307
15	97	.942	.885	750	27.4	1.459
20	92	.961	.923	1107	33.3	1.638
25	87	.975	.949	1626	40.3	1.849
30	82	.981	.961	2023	45.0	2.107
35	77	.981	.963	1987	44.6	2.443
40	72	.979	.958	1633	40.4	2.884
45	67	.977	.954	1397	37.4	3.460
50	62	.980	.959	1448	38.1	4.210
55	57	.985	.971	1880	43.4	5.144
60	52	.981	.963	1331	36.5	6.060
65	47	.972	.944	789	28.1	6.907
70	42	.957	.914	450	21.2	8.021

75	37	.956	.912	384	19.6	9.769
80	32	.972	.943	532	23.1	11.661
85	27	.987	.972	950	30.8	12.648
90	22	.931	.860	136	11.7	10.437
95	17	.884	.767	57	7.6	7.786
100	12	.941	.875	85	9.2	7.806
105	7	.972	.935	102	10.1	1.555
II - Literacy rate as a function of real per capita gross domestic product						
-5	103	.817	.664	204	14.3	1.037
-10	103	.815	.660	201	14.2	1.488
-15	103	.846	.713	257	16.0	2.345
-20	103	.859	.735	286	16.9	3.251
-25	103	.841	.704	246	15.7	3.852
-30	103	.805	.645	188	13.7	4.190
-35	103	.768	.587	147	12.1	4.322
-40	103	.745	.551	127	11.3	4.471
-45	102	.714	.505	105	10.2	4.812
-50	97	.670	.443	78	8.8	5.013
-55	92	.643	.407	64	8.0	5.079
-60	87	.716	.507	90	9.5	5.450
-65	82	.884	.778	289	17.0	6.522
-70	77	.903	.813	336	18.3	6.432
-75	72	.885	.78	256	16.0	6.262
-80	67	.842	.705	161	12.7	5.910
-85	62	.779	.600	94	9.7	5.465
-90	57	.694	.472	52	7.2	4.988
-95	52	.575	.317	25	5.0	4.742
-100	47	.415	.154	10	3.1	3.873
-105	42	.220	.025	2	1.4	.025
-110	37	.100	-.017	4E - 1	0.6	-.012
-115	32	.248	.031	2	1.4	-.036
-120	27	.361	.097	4	2.0	-.069
-125	22	.302	.047	2	1.4	-.077
-130	17	.160	-.035	4E - 1	0.6	.44
-135	12	.420	.102	2	1.5	.175
-140	7	.588	.237	3	1.8	.270

TABLE C

Regional literacy rates in Portugal

Region	1878	1890	1900	1911	1920	1930	1940	1950	1960	1970	1981
Aveiro	15.1	17.2	21.2	25.0	30.5	33.0	43.8	54.9	61.4	69.1	76.1
Beja	12.9	15.5	14.8	16.1	19.1	21.0	27.0	36.5	49.8	55.5	60.8
Braga	18.9	19.6	22.2	24.0	26.1	28.2	35.7	45.2	54.7	63.0	72.6
Bragança	14.8	15.4	16.6	18.3	21.4	24.3	34.5	45.8	54.3	60.3	67.5
Castelo Branco	11.0	12.7	13.5	15.6	17.7	19.7	29.2	42.0	53.2	58.1	64.2
Coimbra	12.5	15.1	16.9	20.9	25.9	30.2	40.6	51.4	59.6	65.3	72.9
Évora	15.9	18.6	17.7	19.8	22.9	26.6	35.0	45.2	55.7	60.7	66.6
Faro	14.3	14.8	16.6	17.9	22.2	26.5	37.7	46.8	57.1	61.1	68.6
Guarda	13.8	16.9	16.3	19.8	24.1	26.6	37.6	48.1	55.7	61.0	68.3
Leiria	11.1	13.2	13.5	16.6	20.3	23.7	34.7	46.7	56.2	62.9	70.7
Lisboa	29.3	38.8	41.1	44.3	48.8	52.4	59.5	67.1	71.9	75.4	80.4
Portalegre	13.6	17.2	16.8	18.2	21.7	26.8	33.3	42.9	54.4	57.9	63.9
Porto	23.9	28.0	29.4	32.9	37.5	39.9	46.8	56.7	63.0	70.3	77.4
Santarém	13.7	16.8	17.9	20.1	23.5	29.0	36.2	48.5	56.1	63.8	71.0
Setúbal	▪	21.3	22.4	23.0	25.0	30.5	36.1	48.4	59.7	68.2	75.1
Viana do Castelo	20.1	23.2	23.2	24.2	27.6	29.3	38.3	48.7	56.3	63.5	70.1
Vila Real	21.6	24.4	23.1	24.8	28.9	29.1	35.5	46.1	53.6	60.3	68.5
Viseu	14.4	15.8	14.6	19.5	24.1	26.9	34.7	47.1	56.6	62.2	68.9
Açores	17.9	23.0	17.6	28.3	34.5	33.3	42.9	53.0	60.2	65.7	69.8
Madeira	9.9	15.5	10.0	17.2	21.7	22.7	29.8	43.1	54.3	58.0	64.6

TABLE D

Regional per capita gross domestic product in Portugal

Region	1938	1947	1950	1955	1960
Aveiro	1587	4284	4494	5611	7570
Beja	1387	3628	3992	4908	6336
Braga	1666	4577	4754	5593	6669
Bragança	1257	3129	3342	4191	5536
Castelo Branco	1388	3678	3908	4918	6175
Coimbra	1492	3835	4097	5077	6839
Évora	1489	3949	4324	5290	6989
Faro	1499	4239	4594	5753	8110
Guarda	1265	3266	3464	4246	5455
Leiria	1372	3703	3919	4983	6972
Lisboa	2399	5763	6203	7911	11761
Portalegre	1516	4082	4464	5307	6822
Porto	1987	5337	5595	6920	9207
Santarém	1525	4088	4412	5381	7037
Setúbal	1797	5127	5591	7016	10109
Viana do Castelo	1578	3853	3968	4828	6060
Vila Real	1346	3381	3629	4347	5443
Viseu	1340	3416	3615	4351	5527
Açores	1279	3491	3843	4688	6108
Madeira	1339	3405	3607	4490	5953

Region	1963	1965	1966	1968	1970
Aveiro	9213	11510	12771	15597	19343
Beja	7571	9200	10106	12501	15517
Braga	8072	10029	10994	13326	16504
Bragança	6375	7507	8059	9724	11764
Castelo Branco	7393	9015	9888	11987	14831
Coimbra	8323	9973	11027	13531	16835
Évora	8626	10617	11794	14760	18658
Faro	9691	11526	13026	16006	19656
Guarda	6517	7912	8589	10508	13037
Leiria	8452	10315	11334	13876	17227
Lisboa	13934	16196	17858	21380	26141
Portalegre	8293	10078	11060	13740	17198
Porto	11036	13401	14869	17907	22040
Santarém	8486	10303	11335	13812	17116
Setúbal	12424	15076	16892	20738	25823
Viana do Castelo	7361	8942	9886	12201	15133
Vila Real	6303	7439	8006	9636	11656
Viseu	6542	7879	8570	10477	12876
Açores	7325	8604	9541	11666	14345
Madeira	7490	9311	10411	13022	16655

Region	1971	1975	1980	1980(*)	1985(*)
Aveiro	21546	39687	122652	133600	348200
Beja	16943	130016	90431	101600	260700
Braga	18480	33830	112020	109000	316000
Bragança	13020	24716	79211	75800	234100
Castelo Branco	16484	30024	98109	94000	297700
Coimbra	18704	34202	112317	118900	331500
Évora	20524	36738	111235	131200	324300
Faro	21543	37098	124335	127100	328100
Guarda	14561	27584	91561	77300	238400
Leiria	19443	36580	112468	118600	320800
Lisboa	28522	49047	152622	204100	579900
Portalegre	18656	32104	96420	120200	337000
Porto	24249	41952	132738	141700	393700
Santarém	19005	34882	110256	124000	321500
Setúbal	28166	47996	134288	168100	461900
Viana do Castelo	16876	31073	97697	76200	222700
Vila Real	13002	25248	83154	73400	208200
Viseu	14413	27862	91295	79700	215600
Açores	15761	28451	90567		
Madeira	18611	33137	111933		

(*) Gross added value
Unit: escudo

TABLE E

Statistical results of cross-section regressions: Portugal

Literacy	GDP	Gap	*r*	r^2	*F*	*t*	*dω*
1878	1938	60	.767	.564	24.261	4.926	1.497
1878	1963	85	.586	.343	8.894	2.982	1.210
1878	1968	90	.505	.255	5.824	2.413	1.204
1890	1938	48	.798	.617	31.628	5.624	1.628
1890	1950	60	.675	.425	15.049	3.879	1.593
1900	1938	38	.894	.789	71.890	8.479	1.961
1900	1955	55	.776	.580	27.249	5.220	1.854
1900	1960	60	.747	.534	22.737	4.768	1.866
1911	1938	27	.817	.649	36.153	6.013	1.529
1911	1947	36	.713	.481	18.590	4.312	1.639
1911	1966	55	.602	.327	10.212	3.196	1.687
1911	1971	60	.543	.295	7.514	2.741	1.661
1920	1947	27	.653	.394	13.365	3.656	1.569
1920	1950	30	.639	.376	12.436	3.527	1.523
1920	1955	35	.641	.378	12.560	3.544	1.559
1920	1975	55	.508	.217	6.271	2.504	1.667
1920	1980	60	.550	.264	7.825	2.997	1.840
1930	1955	25	.752	.541	23.370	4.834	1.908
1930	1960	30	.752	.542	23.490	4.847	2.003
1930	1965	35	.692	.450	16.558	4.069	1.917
1940	1960	20	.691	.448	16.437	4.054	2.034
1940	1965	25	.627	.359	11.656	3.414	1.927
1940	1970	30	.561	.276	8.253	2.873	1.87
1940	1975	35	.583	.303	9.272	3.045	1.911
1950	1975	25	.595	.318	9.868	3.141	1.857
1950	1980	30	.647	.386	12.934	3.596	2.031
1960	1980	20	.758	.551	24.227	4.927	1.979

GDP – gross domestic product
r – correlation coefficient
r^2 – adjusted coefficient of determination
F – *F* statistic
t – *t statistic*
dω – Durbin-Watson statistic

TABLE F

Statistical results of cross-section regressions: mainland

Literacy	GDP	Gap	*r*	r^2	*F*	*t*	dω
1878	1938	60	.805	.625	27.685	5.262	1.396
1878	1963	85	.603	.321	8.567	2.927	1.174
1878	1968	90	.539	.243	6.146	2.479	1.143
1890	1938	48	.856	.715	43.681	8.784	1.880
1890	1950	60	.704	.464	15.714	3.964	1.790
1900	1938	38	.910	.818	77.151	8.784	1.880
1900	1955	55	.769	.565	23.084	4.805	1.863
1900	1960	60	.744	.526	19889	4.460	1.877
1900	*1985	85	.693	.448	14.812	3.849	1.519
1911	1938	27	.897	.793	65.980	8.123	1.808
1911	1947	36	.769	.566	23.181	4.815	1.917
1911	1966	55	.653	.390	11.868	3.445	1.782
1911	1971	60	.605	.326	9.221	3.037	1.715
1920	1947	27	.731	.506	18.38	4.287	1.891
1920	1950	30	.703	.462	15.602	3.950	1.817
1920	1955	35	.707	.468	15.946	3.993	1.834
1920	1975	55	.595	.314	8.771	2.962	1.763
1920	1980	60	.659	.399	12.274	3.503	1.831
1920	*1980	60	.606	.327	9.272	3.045	1.000
1930	1955	25	.779	.583	24.762	4.976	2.136
1930	1960	30	.780	.583	24.801	4.980	2.180
1930	1965	35	.731	.505	18.346	4.283	2.043
1930	*1985	55	.747	.531	20.223	4.497	1.775
1940	1960	20	.725	.496	17.709	4.208	2.201
1940	1965	25	.676	.423	13.439	3.666	2.057
1940	1970	30	.619	.344	9.934	3.152	1.963
1940	1975	35	.652	.389	9.934	3.152	1.963
1950	1975	25	.656	.395	12.119	3.481	1.973
1950	1980	30	.733	.508	18.525	4.304	2.100
1950	*1980	30	.644	.379	11.359	3.370	1.814
1950	*1985	35	.688	.441	14.389	3.379	1.852
1960	1980	20	.834	.676	36.484	6.040	2.045
1960	*1980	20	.777	.578	24.313	4.931	1.879
1960	*1985	25	.813	.640	31.242	5.589	1.870

GDP – gross domestic product
r – correlation coefficient
r^2 – adjusted coefficient of determination
F – *F* statistic
t – *t statistic*
dω – Durbin-Watson statistic
(*) Gross added value

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